SUMMONING A NEW ARTIFICIAL INTELLIGENCE PATENT MODEL:
IN THE AGE OF PANDEMIC

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Abstract:

To combat the fast-moving spread of the pandemic we need an equally speedy and powerful tool. On the forefront against COVID-19, for example, AI technology has become a digital armament in the development of new drugs, vaccines, diagnostic methods, and forecasting programs. Patenting these new, nonobvious, and efficient technological solutions is a critical step in fostering the research and development, the huge investments as well as the commercial processes. This article considers the challenges of the current patent law as they apply to AI inventions in general and especially in the age of a global pandemic. The article proposes a novel solution to the hurdles of patenting AI technology by establishing a new patent track model for AI inventions (including the inventions that are made by AI systems and creative AI systems themselves). Unlike other publications promoting either complete abandonment of AI related patents, or advocating to maintain current patent laws, or recommending minor adjustment to patent laws, this article suggests a novel model of separate patent venue solely targeting AI inventions. The argument of this article is based on four pillars: the difficulty of having a patent-eligible subject matter, the hurdle of the "blackbox" conundrum, the confusion of who is "a person of ordinary skills in the art" ("POSITA"), and the criticality of establishing a new AI patent track model, a crucial step, especially during a global epidemic.

The first pillar of the argument is the difficulty of having a patent-eligible subject matter in AI inventions. We therefore propose the new AI patent track model that would extend the

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scope of patent protection to cover creative AI systems, including both the algorithms and trained models, and AI-made inventions in order to, inter alia, incentivize investments of the "Multi-Players".

The second pillar of the argument of the argument is the hurdle posed by the "blackbox" conundrum of AI systems that undermines the explainability and transparency of the inventions. In analogy to already existing rules applied to microorganism patents that are hard to describe, we advise a depository rule for AI working models to sufficiently describe the otherwise inexplicable inventions.

The third pillar arises from the confusion of who is a person of ordinary skills in regard to the nonobviousness assessment of AI inventions. We submit an alternative standard of "a skilled person using an ordinary AI tool in the art" under the new track model to enable the evaluation of the patentability of complex AI inventions.

The fourth pillar of the argument is the criticality of establishing a new AI patent track model on the grounds that the current patent law regime has posed substantial hurdles and uncertainties for patenting AI inventions with regard to almost all patentability requirements. We analyzed each of the requirements to demonstrate that most, if not all, aspects of patent law are not suitable in the AI era; only a revolutionary new patent model specific for AI inventions could solve all the concerns while maintaining the patent incentive for innovations.

Our model also suggests an expedited examination with the aid of AI tools and a shortened patent lifetime in light of the fast AI development and technology elimination speed. The article concludes with the hope to harness AI technology for the wellbeing of humanity, in general and especially during tough times in the current COVID-19 era and in general.

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I.   INTRODUCTION

COVID-19 has created a worldwide pandemic, causing millions of infections and hundreds of thousands of deaths within only a few months,[1] the lack of vaccine or FDA approved drugs and the unavailability of well-established diagnostic tests have all aggravated the global health crisis.[2] To address the fast-moving spread of the virus, we need an equally speedy tool to assist us efficiently combat the implications of the pandemic. On the forefront against COVID-19, AI technology has become our powerful tool in the development of new drugs, vaccines, and diagnostic methods.[3] AI platforms have also been constructed to track and forecast

the outbreaks, process health claims, manage drones and robots to deliver supplies, identify high-risk individuals, and provide consultation information.[4]

Within several days, the Korean biotech company Seegene utilized an AI system to create a novel coronavirus testing method—an unprecedented short period of time as it usually takes several months with a large group of scientists to develop such testing protocol.[5] Chinese tech giant Alibaba developed an AI based platform to detect coronavirus complication in CT scans of patients' chest with 96% accuracy.[6] While an experienced doctor generally needs about 15 minutes to decipher one CT scan, Alibaba's AI system takes only 20 seconds to generate a diagnostic result which could be based on more than 300 CT images.[7] Moreover, the AI system from the Canadian startup Bluedot successfully predicted the virus outbreak even before the World Health Organization (WHO) officially declared the discovery of a novel coronavirus.[8] Every moment, the Bluedot's AI is collecting and learning COVID-19 related data, such as news, medical databases, public health reports, expert statements, transportation and climate pattern, in an effort to continuously provide the up-to-date forecast and risk assessment of the fast movement disease.[9]

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[4] *Id.*

[5] *Inside the Company That Used AI to Create a Coronavirus Test,* CNN (Mar. 12, 2020), https://edition.cnn.com/videos/world/2020/03/12/south-korea-seegene-coronavirus-test-kit-watson-vpx.cnn (AI accelerated the research speed and helped a group of Korean scientists come up with coronavirus testing kits within 2 weeks).

[6] Tristan Greene, *Alibaba's New Ai System Can Detect Coronavirus in Seconds With 96% Accuracy*, TNW (Mar. 2, 2020), https://thenextweb.com/neural/2020/03/02/alibabas-new-ai-system-can-detect-coronavirus-in-seconds-with-96-accuracy/.

[7] *Id*.

[8] Eric Niler, *An AI Epidemiologist Sent the First Warnings of the Wuhan Virus*, WIRED (Jan. 25, 2020), https://www.wired.com/story/ai-epidemiologist-wuhan-public-health-warnings/ ("The BlueDot algorithm scours news reports and airline ticketing data to predict the spread of diseases like those linked to the flu outbreak in China.").

[9] Ben Dickson, *Why AI might be the most effective weapon we have to fight COVID-19*, TNW, https://thenextweb.com/neural/2020/03/21/why-ai-might-be-the-most-effective-weapon-we-have-to-fight-covid-19/ (last visited Apr. 18, 2020).

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The examples all highlight several crucial features of AI tools—they are extraordinarily efficient, accurate, creative, evolving, and rapid.[10] These features enable the AI tools to become the most capable weapons and armors we have to fight COVID-19.[11] Acknowledging the AI power, the White House urged researchers to employ AI to analyze tens of thousands of papers to decipher the origins of coronavirus.[12] U.S. Chief Technology Officer Michael Kratsios from the White House explained the agency's hope is that AI will be able to scan the research more quickly than a human and also uncover findings that humans may miss.[13] Indeed, the AI technology is capable to detect patterns automatically based on an enormous amount of data. While grouping the similarities and differences in the digital pieces of data, the AI system continues improving the results by learning and evolving, rendering the generation of new predictions and inventions.[14] Nevertheless, the race to the vaccine goes through patent applications. Can AI-generated drugs be patented? This question raises a more general discussion: are AI inventions patentable? Are patent laws relevant and applicable? This discourse is the main focus of the article. We hold that in order to incentivize the players and encourage investments in creative AI systems (including AI algorithms and AI trained models), AI-made inventions must be patentable. However, as the law stands human inventors are only eligible for patent ownership, therefore, a new model is needed.

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[10] Shlomit Yanisky-Ravid, *Generating Rembrandt: Artificial Intelligence, Copyright, and Accountability in the 3A Era—the Human-like Authors Are Already Here—a New Model*, 2017 MICH. ST. L. REV. 659, 679-681 (2017) (identifying ten features of AI systems' algorithms).

[11] *See* Tizia-Charlotte Frohwitter, *How Artificial Intelligence Is Supporting Humanity in the Battle Against Coronavirus,* OBSERVER (April 1, 2020) https://fordhamobserver.com/45135/opinions/how-artificial-intelligence-is-supporting-humanity-in-the-battle-against-coronavirus/.

[12] Paresh Dave, *White House Urges Researchers to Use Ai to Analyze 29,000 Coronavirus Papers,* Reuters (Mar. 16, 2020)

[13] *Id.*

[14] Yanisky-Ravid, *supra* note 10, at 680 ("As a result of the new input and the AI system's capacity for continuous processing, the system might constantly find new patterns and similarities and hence change the outcomes. In this sense, the system is constantly evolving.").

Many of the anti-coronavirus tools developed utilizing AI technology, ranging from drugs, vaccines, diagnostics, to medical devices, and robotics, should be patentable to encourage investments and to incentivize the creators along the process.[15] Currently, scholars are debating whether the patent term should be extended beyond 20 years in order to maximize the incentive to innovations or whether the patent rights should be suspended so as to bring the otherwise patented cure to the public domain.[16] However, these discussions entirely miss the issue of applicability of patent law to AI involved inventions. This question is the main focus of this article.

When talking about AI inventions, there are generally two types of innovative AI applications. One type of AI inventions are creative AI systems themselves, often referred to as "creativity machines" which are capable of generating new inventions themselves. They are comparable to powerhouses of creativity to brainstorm innovations without human interference. The other type of AI inventions are AI-made inventions, in other words the resulting inventions generated by the AI systems. To illustrate the two kinds of AI innovations, we refer to the example of Dabus, an AI system that independently created two inventions—a beverage container of unique geometry and a lighting device that flickers in a rhythm mimicking neural activity.[17] The Dabus system is the creative AI system itself, while the two inventions that Dabus

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[15] *See*, *e.g.*, Regina Jin, *Potential Coronavirus Drug: Patent Rights Amid Global Pandemic,* FORDHAM INTELLECTUAL PROP. MEDIA ENTM'T L.J. (Apr. 3, 2020), http://www.fordhamiplj.org/2020/04/03/potential-coronavirus-drug-patent-rights-amid-global-pandemic/ (discussing patents rights of a potential coronavirus drug for which both an American company and a Chinse Institute have filed patent applications).

[16] Adam Mossoff, *Patent Term Extensions Will Help Speed up Development of Coronavirus Drugs,* HUDSON INSTITUTE (Mar. 12, 2020), https://www.hudson.org/research/15811-patent-term-extensions-will-help-speed-up-development-of-coronavirus-drugs (proposing patent term extension for coronavirus drugs to incentivize the drug development); Hugo Miller et al., *Coronavirus Crisis May Bring Out Old Tool in Disease Fights: Suspension of Drug Patents*, FORTUNE (Apr. 2, 2020), https://fortune.com/2020/04/02/coronavirus-crisis-suspension-drug-patents/ (highlighting the patent suspension power reserved by the governments of several countries, such as Israel, U.K., and Germany, to potentially bring coronavirus drug patents to open source).

[17] *Id.*

generated are AI-made inventions. Dabus was the first AI system to be listed as an inventor in the filed patent applications.[18] But months after the patent filing, both European Patent Office (EPO) and United Kingdom Intellectual Property Office (UKIPO) rejected the Dabus patent applications on the grounds that only human beings can be regarded as inventors.[19]

The AI "creativity machines" and AI-made inventions have posed challenges for the current patent law regime, which was instituted in an era when AI technology was still absent. Realizing the uncertain issues of patent law in the AI era, the USPTO (United States Patent and Trademark Office) published a Request for Comments on Patenting AI Inventions on the Federal Register in August 2019, hoping to summon public inputs to answer questions such as whether certain aspects of patent law need to be revised to whether new forms of IP protection are necessary.[20] The USPTO has also requested for comments regarding AI copyright issues to discuss, for instance, whether a creative work produced by AI without human involvement qualifies as a protectable work or what kind of human involvement is necessary to render copyright protection.[21] So far the USPTO has not responded to the public comments or issued any official guidelines regarding patent rights or copyrights in respect of AI inventions.

Scholars have mostly addressed the AI implications to the patent law by analyzing two questions: first, whether the current law is still applicable and relevant;[22] and second, whether a creative AI system like Dabus can replace human inventors and be the actual inventor of the

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[18] Tina G Yin Sowatzke, *Meet DABUS: An Artificial Intelligence Machine Hoping to Maintain Two Patent Applications in its own Name,* MCKEE, VOORHEES & SEASE (Aug. 22, 2019), https://www.filewrapper.com/filewrapper/meet-dabus-an-artificial-intelligence-machine-hoping-to-maintain-two-patent-applications-in-its-own-?filewrapper=true.

[19] James Nurton, *EPO and UKIPO Refuse AI-Invented Patent Applications*, IP WATCHDOG (Jan. 7, 2020), https://www.ipwatchdog.com/2020/01/07/epo-ukipo-refuse-ai-invented-patent-applications/id=117648/.

[20] *Request for Comments on Patenting Artificial Intelligence Inventions*, 84 Fed. Reg. 166 (Aug. 27, 2019).

[21] *Request for Comments on Patenting Artificial Intelligence Inventions,* 84 Fed. Reg. 210 (Oct. 20, 2019).

[22] Shlomit Yanisky-Ravid & Xiaoqiong (Jackie) Liu, *When Artificial Intelligence Systems Produce Inventions: an Alternative Model for Patent Law at the 3a Era*, 39 Cardoza. L. Rev. 2215, 2215 (2018).

patent. [23] Other issues examined by scholars, for instance, focus on the patent examination process for AI inventions,[24] the ownership of AI inventions,[25] and patent infringement by AI.[26]

There are generally three distinctive opinions in regard to patent protection of AI inventions. The first view stems from patent protagonists' support of creative AI systems and belief that AI systems can replace human inventors and should therefore be the recognized patent inventors. In the 3A era of the advanced, automated, and autonomous technology, an AI system is capable of creating the inventions without human inference.[27] AI's independent inventive act results in a natural conclusion that an AI system is entitled to rights and duties as an inventor. Ryan Abbott, a U.K. professor of law and member of the Dabus developing group, suggests that AI-made inventions should be patentable and an AI creative system itself should be considered the inventor and possess corresponding inventorship rights.[28] Donald Chisum, a well-known patent scholar, also supports patent rights of digital tools by maintaining that creative computer algorithms should be patentable.[29] The second view on patent protection of AI inventions is from AI patent antagonists, who focus on the irrelevancy of the current patent system in the AI context. One author of this paper, Professor Shlomit Yanisky-Ravid, argues that "traditional patent law has

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[23] Robert Jehan, *Should An AI System Be Credited As An Inventor*, ARTIFICIAL INVENTOR PROJECT (Aug. 24, 2019), http://artificialinventor.com/should-an-ai-system-be-credited-as-an-inventor-robert-jehan/.

[24] Tabrez Y. Ebrahim, *Automation & Predictive Analytics in Patent Prosecution: USPTO Implication & Policy*, 35 Ga. St. U. L. Rev. 1185, 1185 (2019).

[25] W. Michael Schuster, *Artificial Intelligence and Patent Ownership*, 75 Wash. & Lee L. Rev. 1945, 1945 (2019).

[26] Center for the Fourth Industrial Revolution, *Artificial Intelligence Collides with Patent Law*, WORLD ECONOMIC Forum 12 (April 2018), http://www3.weforum.org/docs/WEF_48540_WP_End_of_Innovation_Protecting_Patent_Law.pdf.

[27] Yanisky-Ravid & Liu, *supra* note 22.

[28] Ryan Abbott, *I Think, Therefore I Invent: Creative Computers and the Future of Patent Law*, 57 57 B.C.L. Rev. 1079 (2016) (arguing that "creative computers should be considered inventors" to incentivize the development of creative computers).

[29] Donald S. Chisum, *The Patentability of Algorithms*, 47 U. Pitt. L. Rev. 959, 976 (1986) (arguing that algorithms, if meeting the standards of novelty and unobvioiusness, should be the subject of patent protection).

become outdated, inapplicable, and irrelevant with respect to inventions created by AI systems."[30] She takes an alternative approach departing from patent protection by proposing an open source system to eliminate the patent rights for all AI inventions for the sake of maximizing the disclosure and development of advanced technology.[31] The third view is based on the status quo approach, under which scholars posit that the patent law should be largely untouched to avoid the burdensome legislative process. To consider minor modifications, new agency rules such as patent office examination guidelines may be issued.[32] Some suggest adding a modification to the patentability test that requires AI inventions to have replicable results.[33] Additionally, some propose a multi-level model applying different criteria of patentability depending on the autonomous level of AI system.[34]

In this article, we suggest a completely novel model that bridges the gaps between the existing three approaches. We argue that the current patent law system is inapplicable per se and propose a new legal paradigm for examining AI inventions. While supporting patent rights similar to the first approach, we also heed to the difficulties and uncertainties of applying the current patent law standards to AI inventions. Disagreeing with the status quo approach, we assert that a revolution

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[30] Yanisky-Ravid & Liu, *supra* note 22.
[31] *Id*, at 2216.
[32] Ana Ramalho, *Patentability of AI-Generated Inventions–Is a Reform of the Patent System Needed?*, FOUNDATION FOR INTELLECTUAL PROPERTY ix (Mar. 31, 2018), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3168703 (carrying out a comparative analysis of the non-obviousness requirement in Japan, the European Union, and the U.S.).
[33] Peter M. Kohlhepp, *When the Invention Is An Inventor: Revitalizing Patentable Subject Matter To Exclude Unpredictable Processes*, 93 Minn. L. Rev. 779, 781 (2008) (arguing that to determine the patent-eligible subject matter, the court must apply common law limits to ensure the accessibility of basic scientific tools and also apply the statutory rule under section 101 to only those inventions that produce predictable results).
[34] Garikai Chimuka, *Impact of Artificial Intelligence on Patent Law. Towards a New Analytical Framework – [the Multi-level Model]*, 59 WORLD PATENT INFO. 101926, 101926 (2019).

is necessary to establish a distinct AI patent track model separating from the current patent regime applied to human-made inventions. Creating a new patent track model for AI inventions is critical because so many factors of the current patent law are inapplicable in the AI context and minor or piecemeal modifications would not address all the existing concerns.

In our proposal, the new AI patent track model provides a distinctive scope of protection for creative AI systems (including innovative AI algorithm and AI trained models) and AI-made inventions—all of which might potentially not be patentable under the current patent regime. To clarify the specifications of AI inventions that may be inherently inexplicable, the track model innovatively requests the deposition of AI working models with the patent office. The new track model also revolutionizes many ambiguous or inapplicable elements of the patent law to be more congruent with the 3A era digital tools in the aspects of the "person skilled in the art" standard, the examination timing and method, and the patent lifetime.

The above Part I of this article introduces the AI inventions that have been created to fight the new coronavirus and brings to light the patent law issues implicated by AI inventions. Part II of this article describes the features of an AI inventor and how an AI system invents. Part III illuminates the various aspects of current patent law being challenged in the AI era, specifically in the aspects of patent-eligible subject matter, obviousness, written description, enablement, utility, novelty, and inventorship. Given that the patent law provisions are not suitable in the AI context, the article argues that the current U.S. patent law casts a cloud of uncertainty over the doomy future of patenting AI inventions, which would only disincentivize innovations. To address the issues detailed in Part III, Part IV suggests a new model as a solution, that is, to establish a specific patent track model for patenting AI inventions. The

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following features are proposed for the new track model: (1) protection of creative AI systems themselves and AI-made inventions, (2) change of the "person skilled in the art" standard to "a skilled person using an ordinary AI tool in the art", (3) expedited patent examination, (4) use of AI in patent examination, (5) shortened patent lifetime, and (6) depository requirement for the AI working model. Finally, Part V discusses potential challenges of the AI specific patent track model and rebutted with arguments.

II. OVERVIEW OF THE INVENTIVE CAPABILITY OF ARTIFICIAL INTELLIGENCE

A. *Not A Science Fiction: An Artificial Intelligence Inventor Is Already Here*

Dabus was the first AI system listed as an inventor in the patent applications, yet it is not the first "creativity machine" to produce inventions. To date AI systems have already generated and created new inventions without human interference. Another example is John Koza's "invention machine", an AI system based on genetic programing modelled after biological evolution for the optimization of complex problems.[35] Not only did John Koza secure patents at the USPTO over his "invention machine", he also obtained patents over the inventions made by the "invention machine" in connection with methods and processes of generating new designs for the industrial controlling systems.[36]

In the COVID-19 climate, AI inventors are actively engaged in generating new testing, forecasting, and treatment methods to cope with the crisis. Behind Seegene's new coronavirus diagnostic tests that were established within days, the company has an AI system that

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[35] Yanisky Ravid & Liu, *supra* note 22, at 2221 (The article argues that "traditional patent law has become outdated, inapplicable, and irrelevant with respect to inventions created by AI systems" and proposes that these inventions should not be patentable at all).
[36] *Id.*

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automatically designs biological assays.[37] Seegene's AI system is not only creative but also much more rapid and efficient than human scientists. A spokesperson from Seegene compared the capability of the company's AI system with that of humans "[t]he performance (sensitivity and specificity) of the assays developed by AI are equivalent to or even better than that of those manually developed" and "[o]nly four (4) days were sufficient by the AI system to successfully develop two 8-plex assays, while more than a year was required by a team of experienced professionals."[38]

　　More examples to demonstrate AI's creativity can be found in the pharmaceutical industry, where AI tools have been extensively applied in the full range of drug discovery from disease target identification to compound screening and from drug design to the prediction of drug potency and toxicity.[39]　A number of new drug targets based on RNA binding proteins were discovered by IBM Watson to cure a neurodegenerative disease.[40] A drug design AI held by AstraZeneca in Cambridge, U.K. have devised a large amount of new drug structures catering to the chemical space that the human may not have thought of.[41] Further, , an AI system, AtomNet, has forecasted the efficacy and toxicity for a vast array of drug candidates so that the scientists only have to test a small number of the most interested ones on the bench.[42] These AI systems not only bring creativity to the industry, but also they speed up the drug discovery process in an efficient and accurate fashion.

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[37] *Seegene's information technologies: SGDDS*, SEEGENE, http://www.seegene.com/company (last visited Apr. 22, 2020).

[38] *Seegene Develops World's First Multiplex Mdx Assays With Its Ai System*, SEEGENE (Jan. 3, 2018), http://www.seegene.com/press_release/seegene_develops_worlds_first_multiplex_mdx_assays_with_its_ai_system.

[39] *Artificial Intelligence for Increased Drug Discovery Efficiency – Machine Learning, Supercomputers, and Big Data*, CAMIN, https://www.camin.com/ai-for-drug-discovery (last visited Nov. 21, 2019).

[40] Nadine Bakkar et al., *Artificial intelligence in neurodegenerative disease research: use of IBM Watson to identify additional RNA-binding proteins altered in amyotrophic lateral sclerosis*, 135 ACTA NEUROPATHOLOGICA 227.

[41] *Id.*

[42] *Introducing AtomNet- – Drug design with convolutional neural networks*, ATOMWISE, https://www.atomwise.com/our-technology/(last visited Nov. 5, 2019).

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Opponents against acknowledging AI inventors often point out that human beings are behind the process.[43] We concede that an AI invention may involve human contributions, such as the work of software programmers in developing the AI system, the data suppliers in providing the data, the trainers in teaching the AI system, and the user in operating the system. However, the human contributions may just be routine, and their work may not be inventive if the AI system is autonomously inventing the subject matter.[44] Following the examples of AI inventors, we must explore how AI systems can invent.

B. How Does an AI System Invent?

We try to understand how an AI system can invent by resorting to the definition of AI. The definitions of AI systems vary depending on the purpose, field, subject matter, and other factors attributable to the AI system at issue. The Marriam-Webster dictionary applies a very general technological explanation and defines AI as "a branch of computer science dealing with the simulation of intelligent behavior in computers" or "the capability of a machine to imitate intelligent human behavior."[45] An AI system's creativity is inherent in its imitation of human intelligence, although it is not necessarily built nor does it function similarly to the brain's neurons and synapses. Based on the understanding of the mathematical-statistical program that underlies the common typed AI systems, one author of this article Professor Shlomit Ravid-Yanisky defines AI by at least eight crucial features that distinguish AI systems from traditional

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[43] *See* Shlomit Yanisky-Ravid & Luis Antonio Velez- Hernandez, *Copyrightability of Artworks Produced by Creative Robots and Originality: The Formality-Objective Model*, 19 Minn. J.L. Sci. & Tech. 1, 13-14 (2018) ("We claim that the current (traditional) legal regime focuses only on what was relevant in the past, namely the human authors behind the creative process.").

[44] Abbott, *supra* note 28, at 1094 ("Computer involvement might be conceptualized on a spectrum: on one end, a computer is simply a tool assisting a human inventor; on the other end, the computer independently meets the requirements for inventorship. AI capable of acting autonomously such as the Creativity Machine and the Invention Machine fall on the latter end of the spectrum.").

[45] *Artificial Intelligence,* MERRIAM-WEBSTER, https://www.merriam-webster.com/dictionary/artificial%20intelligence?utm_campaign=sd&utm_medium=serp&utm_source=jsonld (last visited Nov. 25, 2019).

software.[46] The definition characterizes AI systems as being (1) creative, (2) unpredictable, (3) independent and autonomous, (4) rational, (5) evolving, (6) capable of data collection and communication, (7) efficient and accurate, and (8) able to choose among other options.[47] The eight features make it possible to set up a flexible and balancing framework to identify AI systems that are intrinsically and functionally multidimensional. When analyzing whether a computer system is based on AI, the satisfaction of some, if not all, features may still give rise to an AI-like system.

Due to the fundamental features that are rooted in every AI program, the systems can creatively, autonomously, and unpredictably perform new tasks in an effort to provide innovative solutions. To generate a new solution, for instance, an AI system powered by genetic algorithm may incorporate random mutations that induce unpredictable results to the optimal solution.[48] It can autonomously select among a vast number of projected results to optimize the solution by filtering away less desirable results.[49] By repeating the process, the system eventually outputs the best solution.[50] Machine learning, a type of AI, is apt to learn from numerous data (e.g., images, video, and sensory data) and look for patterns, and it can also improvise by outputting new data that could fit within the existing patterns.[51] The CEO of Semantic, an AI graphics company, explains how his AI system creates new drawings "[i]f you feed it thousands of paintings and

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[46] Yanisky-Ravid & Liu, *supra* note 22, at 2216-2017.

[47] *Id.*

[48] *See* Matte Harvey, *Let's Evolve A Neural Network With A Genetic Algorithm—Code Included*, COASTLINE AUTOMATION, https://blog.coast.ai/lets-evolve-a-neural-network-with-a-genetic-algorithm-code-included-8809bece164 (last visited Nov. 27, 2019).

[49] *See Genetic Algorithms*, GEEKSFORGEEKS, https://www.geeksforgeeks.org/genetic-algorithms/ (last visited Apr. 18, 2020) ("Genetic algorithms simulate the process of natural selection which means those species who can adapt to changes in their environment are able to survive and reproduce and go to next generation. In simple words, they simulate "survival of the fittest" among individual of consecutive generation for solving a problem.").

[50] *See id.*

[51] Connor Shorten, *Unsupervised Feature Learning*, TOWARDS DATA SCIENCE, https://towardsdatascience.com/unsupervised-feature-learning-46a2fe399929 (last visited Nov. 25, 2019).

pictures, all of a sudden you have this mathematical system where you can tweak the parameters or the vectors and get brand new creative things similar to what it was trained on".[52] Nevertheless, the AI developer may not know the details of how an AI system invent. AI systems, in particular the deep neural networks, are notoriously opaque. This phenomenon is called the "blackbox" conundrum given that the systems seldom offer detailed clues in regard to how they arrive at their conclusion.[53]

In this article, we discuss the implications of creative AI systems in the current patent law regime. These AI systems are capable to generate inventions which, had been developed by humans, might qualify to have patent protections. We seek to address a few questions: can the creative and inventive AI system have patent protection itself? Can the new inventions, in the form of products or processes, produced by the AI system be patentable? Should the process of examining AI inventions, including both creative AI systems and AI-made invention, be distinguished from the examining process of human-made inventions? The challenges in patenting creative AI systems and AI-made inventions are discussed below.

III. THE PATENTABILITY IMPLICATED BY AI INVENTIONS

To ripen into a patent under the U.S. law, an invention must fulfill a line of requirements, including reciting patent-eligible subject matter and having the qualities of novelty, nonobvisouness, and utility. These criteria are used to ensure the exclusive 20-year rights of making, using, selling, and importing the invention are only granted to the deserving inventions

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[52] *The Quest for AI Creativity,* IBM, https://www.ibm.com/watson/advantage-reports/future-of-artificial-intelligence/ai-creativity.html (last visited Nov. 25, 2019).

[53] Ariel Bleicher, Demystifying the Black Box That Is AI, Sci. Am. (Aug. 9, 2017), https://www.scientificamerican.com/article/demystifying-the-black-box-that-is-ai/ ("Therein lies today's AI conundrum: The most capable technologies—namely, deep neural networks—are notoriously opaque, offering few clues as to how they arrive at their conclusions.").

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that contribute to the total welfare of society.[54] The following explores each of the patent requirement and demonstrates how the AI technology challenges each element of the current patent regime. This article argues that AI inventions, including both creative AI systems themselves and AI-made inventions, do not align with the traditional patent law framework, and therefore we summon a new patent model that is tailored specifically to protect the nuances of AI technology.

A. Patent-Eligible Subject Matter

Under 35 USC 101, patent-eligible subject matter is defined as a "new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof".[55] The Supreme Court cautioned that "laws of nature, physical phenomena, and abstract ideas" are patent-ineligible concepts.[56] In the landmark case *Alice Corporation Pty. Ltd. v. CLS Bank International*, the Supreme Court applied a two-step test in determining patentability of an invention, where the first step is to "determine whether the claims at issue are directed to one of those patent-ineligible concepts" and the second step is to "consider the elements of each claim both individually and 'as an ordered combination' to determine whether the additional elements 'transform the nature of the claim' into a patent-eligible application" in search of "inventive concept."[57] Below we assert that the subject-matter eligibility requirement creates difficulties and uncertainties for patenting AI inventions.

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[54] *See General Information Concerning Patents*, USPTO (Oct. 2015), https://www.uspto.gov/patents-getting-started/general-information-concerning-patents.

[55] 35 U.S.C. 101 (2019).

[56] Diamond v. Diehr, 450 U.S. 175, 185 (1981) (the Supreme Court restated the judicial exceptions in the case and held that controlling the execution of a physical process by running a computer problem, does not preclude patentability).

[57] Alice Corp. Pty. v. CLS Bank Int'l, 573 U.S. 208, 217 (2014) (the Alice two-step test, though not explicitly mentioned for computer applications in the opinion, has a dramatic effect on the Federal district holdings to invalidate software patents and business-method patients).

First, a creative AI system and an AI-made invention are likely to be characterized as reciting patent-ineligible mental steps.[58] AI emerges from the simulation of human intelligent behavior in the fashion of processing, inputting, and outputting information, hence an AI system may inherently has some features of the human mind.[59] After *Alice*, the Federal Circuit and district courts have invalidated a series of computer related process and system claims on the grounds that they are abstract mental steps.[60] The doctrine of mental steps has already been used to strike down AI patent claims. In an AI based patent that is directed to a digital watermark technology, the court held that the patent claims are invalid because the process of identifying digital watermarks models "the highly effective ability of humans to identify and recognize a signal".[61]

In response to the coronavirus crisis, Megvii, a Chinese technology company developed a fever reporting AI platform by integrating facial detection with body temperature sensing.[62] The AI's face recognition ability may arguably incorporate human mental steps of identifying distinctive details of a person's face such as the distance between the eyes or shape of the chin.[63] The fever reporting platform might allegedly relate to the abstract ideas of image recognition

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[58] Ben Hattenbach & Gavin Snyder, *Rethinking the Mental Steps Doctrine and Other Barriers to Patentability of Artificial Intelligence*, 19 Colum. Sci. & Tech. L. Rev. 313 (2018).

[59] *See Artificial Intelligence*, Merriam-Webster, https://www.merriam-webster.com/dictionary/artificial%20intelligence (last visited Nov. 15, 2019).

[60] *See e.g.*, CyberSource Corp. v. Retail Decisions Inc., 654 F.3d 1366, 1372 (Fed. Cir. 2011); Fair Warning IP v. Iatric Sys., Inc., 839 F.3d 1089, 1097 (Fed. Cir. 2016); Intellectual Ventures I v. Erie Indem. Co., 711 F. App'x 1012 (Fed. Cir. 2017) (patents in these cases all being invalidated by failing to fulfill the two-step Alice test).

[61] Blue Spike v. Google Inc., No. 14-CV-01650-YGR, 2015 WL 5260506 (N.D. Cal. Sept. 8, 2015), aff'd, 669 F. App'x 575 (Fed. Cir. 2016) ("The patents seek to 'model,' on a computer, "the highly effective ability of humans to identify and recognize a signal.").

[62] Coco Feng, *Coronavirus: AI firms deploy fever detection systems in Beijing to fight outbreak*, S. China Morning Post (Feb. 6, 2020), https://www.scmp.com/tech/policy/article/3049215/ai-firms-deploy-fever-detection-systems-beijing-help-fight-coronavirus.

[63] Street-Level Surveillance: Face Recognition, Elec. Frontier Found., https://www.eff.org/pages/face-recognition (last visited Apr. 22, 2020).

undertaken within the human mind and thus may not necessarily patentable; The frustration from securing patents may discourage AI researchers to develop AI tools of this kind.

Second, an AI system is likely to be deemed a data manipulating mathematical operation, which is not patentable.[64] The Supreme Court defines "algorithm" as "[a] procedure for solving a given type of mathematical problem" and held that a mathematical algorithm without substantial practical application is abstract and not patentable.[65] An AI system intrinsically has some underlying algorithm inherently suspect of patent ineligibility. Donald Chisum argues that the Supreme Court's definition of "algorithm" only to mathematical concepts is limited because "algorithms may also be devised to solve all sorts nonmathematical problems."[66] We further emphasize that the non-numerical feature of an AI algorithm is especially pronounced given that AI has been devised for machine learning, decision management, text analytics, language generation, and speech recognition.[67] Hence it is unpersuasive to reject an AI patent on the mere ground that it is directed to a mathematical concept.

In the pandemic age, the forecasting AI systems are conducting creative acts rather than merely utilizing mathematical concepts. For example, the Bluedot's machine learning AI platform predicted the outbreak before the WHO's officially declared the COVID-19 discovery.[68] Chan Zuckerberg's Biohub is building an AI tool to estimate the unreported coronavirus infections and Stanford university researchers are repurposing an AI system to

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[64] Gottschalk v. Benson, 409 U.S. 63, 65 (1972) (the Supreme Court ruled that a process claim directed to a numerical algorithm was not patentable because "the patent would wholly pre-empt the mathematical formula and in practical effect would be a patent on the algorithm itself").
[65] *Id.*
[66] *Supra* note 29.
[67] Gil Press, *Top 10 Hot Artificial Intelligence (AI) Technologies*, FORBES (Jan. 23, 2017), https://www.forbes.com/sites/gilpress/2017/01/23/top-10-hot-artificial-intelligence-ai-technologies/#5d1cf30d1928.
[68] Niler, *supra* note 8.

predict which group of patients require more medical intervention than others.[69] Even though

there are human programmers, data suppliers, trainers, and users behind the forecasting AI

systems, these systems independently perform the innovative part of the work, i.e. forecasting

the disease spread and the infectious severity by learning from various information from, e.g.

public health authorities, databases, social media, news, governmental guidelines, transportation,

and climate patterns.[70] Regardless of the creativity of the algorithms, these AI systems may be

potentially asserted as abstract mathematical algorithms ineligible for patent protection—the

possibility may deter the AI researchers from developing and training systems or from devising

new underlying algorithm that may be fundamental to practical solutions.

   Third, a creative AI system may be ineligible to yield a patent because "generic computer

implementations" are not patent-eligible.[71] Under the machine-or-transformation test, the subject

matter is eligible when it "is tied to a particular machine or apparatus" or "transforms [a]

particular article into a different state or thing".[72] It seems that a creative AI system, if

considered as a machine, could satisfy the machine-or-transformation test.[73] However, as the

Supreme Court states that the machine-or-transformation test is not the sole test to determine if a

process is patentable,[74] if the system is just a computer program in the form of a machine it may

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[69] Susan Robertson, *COVID-19 + AI Virtual Conference*, INNOVATORS (Mar. 24, 2020),
https://www.innovatorsmag.com/covid-19-ai-virtual-conference/; Anne Zieger, *Stanford Tests Machine Learning To Manage COVID-19 Surge*, HEALTHCARE IT TODAY (Apr. 8, 2020),
https://www.healthcareittoday.com/2020/04/08/stanford-tests-machine-learning-to-manage-covid-19-surge/.
[70] *See* Dickson, *supra* note 9.
[71] Alice Corp. Pty. v. CLS Bank Int'l, 573 U.S. 208, 221 (2014) (holding that a "generic computer implementation" is not patentable).
[72] Bilski v. Kappos, 561 U.S. 593, 602 ("Under the Court of Appeals' formulation, an invention is a 'process' only if: '(1) it is tied to a particular machine or apparatus, or (2) it transforms a particular article into a different state or thing.'").
[73] Yanisky-Ravid & Liu, *supra* note שגיאה! הסימניה אינה מוגדרת., at 2247 (providing that AI made inventions fulfill the machine-or-transformation test because "the thought processes are reduced to either physical transformation or the architecture of the machine itself").
[74] Bilski, 561 U.S. at 603 ("Adopting the machine-or-transformation test as the sole test for what constitutes a 'process' (as opposed to just an important and useful clue) violates these statutory interpretation principles.").

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still be stricken down on the theory that it is a "generic computer implementation" under *Alice*.[75] Assuming there is an AI creativity system that is able to generate new inventions in a wide scope of fields, the system itself may not have patent protection as purportedly being a generic computer implementation. In contrast, if the AI creativity system is only applicable to generate solutions in one field, the system may not be considered generic and thus be patentable. Ironically, the theory to prohibit the patent rights of generic creativity machines may generate undesirable results—researchers are disincentivized to develop powerful AI creativity machines with a broad range of applications; rather, they are encouraged to dive deep into developing a seemingly less versatile AI tool that is useful in only one field.

The fourth hurdle of patenting AI inventions is specific to new AI medical diagnostic tools since courts may find the identification of the relationship between a disease and a physiological level as just a law of nature.[76] In *Mayo Collaborative Servs. v. Prometheus Labs., Inc.*, the Supreme Court invalidated patent claims directed to the relationship between the blood concentration of certain metabolites and the likelihood of drug efficacy or harm on the grounds that such relationship is a law of nature.[77] The Federal Circuit has followed the *Mayo* decision to invalidate many medical diagnostic patents under the theory that the diagnostics are laws of nature.[78] The urgency to have efficient coronavirus diagnostic tools cannot be emphasized

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[75] *See* Alice 573 U.S. at 208. In contrast, in *Enfish v. Microsoft*, the Federal Court found that "a specific improvement to the way computers operate" is patent-eligible. 208. 822 F.3d 1327, 1336 (Fed. Cir. 2016).

[76] Susan Y. Tull & Paula E. Miller, *Patenting Artificial Intelligence: Issues of Obviousness, Inventorship, and Patent Eligibility*, 1 J. ROBOTICS, ARTIFICIAL INTELLIGENCE & L. 313, 316 (2018).

[77] 566 U.S. 66, 69 (2012) (invalidating patent claims directed to identify the relationship between the blood concentration of certain metabolites and the likelihood of drug efficacy or harm and pointing out such relationship is law of nature).

[78] *See e.g.*, Ariosa Diagnostics, Inc. v. Sequenom, Inc., 788 F.3d 1371, 1376, 1379 (Fed. Cir. 2015); Cleveland Clinic Found. v. True Health Diagnostics, 859 F.3d 1352, 1363 (Fed. Cir. 2017) (these cases invalidated medical diagnostic patents for being related to laws of nature). In the recent case Athena Diagnostics v. Mayo Collaborative Services, even if the majority recognized that protection of diagnostic methods would be for good for society, they were still compelled by Supreme Court precedent to affirm patent ineligibility of diagnostic method claims.

enough in the pandemic time. Many research groups have taken advantage of AI technology in coronavirus diagnostics. The voice samples of coronavirus patients were collected by the Israel company Vocalis Health which subsequently analyzed the samples using an AI based algorithm with the aim to identify the unique vocal "fingerprint" for diagnosing the disease.[79] An Amazon supported Canadian group built an AI platform to test COVID-19 based on the quickly scanned CT images of the patient's chest instead of the current time-consuming polymerase chain reaction (PCR) tests.[80] Their AI platform is also empowered to correlate the CT image of lungs with the severity of the coronavirus case.[81] The new AI diagnostic tools may not necessarily gain patent rights simply due to the Court's holding that medical diagnostic tools are related to laws of nature and thus ineligible for patent protection; as a result researcher may be less driven to work out the possibility of a new AI diagnostic tool.

Based on the above four points, creative AI systems and the inventions made by AI systems, especially of medical diagnostic tools, may recite patent ineligible subject matters. Yet patenting the invention is extremely important and a deprivation of patent rights may impede the professionals from seeking solutions to the problem. In face of the pandemic, the lack of incentive without predictable patent rights would lead to an unclear pathway of monetary returns for the biomedical companies, which would "frown" on the investment of new cures. To solve the problem, we suggest that the AI inventions, including creative AI systems and AI-made inventions, should be patentable. The patentability of such subject matters would incentivize

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[79] *Israeli Defense Ministry Launches COVID-19 Voice-Test Study*, REUTERS (Mar. 24, 2020), https://www.reuters.com/article/us-health-coronavirus-israel-study/israeli-defense-ministry-launches-covid-19-voice-test-study-idUSKBN21B2YV.

[80] Maneet Ahuja & Katie Jennings, *Exclusive: Amazon Is Powering The Coronavirus Diagnostics Of The Future*, FORBES (Apr. 13, 2020), https://www.forbes.com/sites/maneetahuja/2020/04/13/exclusive-amazon-is-powering-the-coronavirus-diagnostics-of-the-future/#2ae4a3a33f44.

[81] *Id.*

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innovation and reward labor—this idea and the theoretical justifications will be discussed later in the article. Next, the obviousness requirement implicated by AI inventions is examined.

B. Obviousness

According to 35 USC 103, "the differences between the claimed invention and the prior art" must not be "such that the claimed invention as a whole would have been *obvious* before the effective filing date of the claimed invention to *a person having ordinary skill in the art to which the claimed invention pertains*."[82] Below we argue that the obviousness test is not applicable to AI inventions.

First, *the person having ordinary skill in the art* ("POSITA") standard has posed obstacles in determining patentability of AI inventions.[83] The obviousness is viewed from the perspective of a POSITA, who is a "hypothetical person who is presumed to be aware of all the pertinent prior art."[84] However, in the AI context, it is unclear who is the POSITA.[85] Is a POSITA the programmer, the AI system, or some other human contributors? A better way to assess the obviousness requirement may be to answer the question in the negative or to look at who cannot be a POSITA. The Supreme Court defines the POSITA as "a person of ordinary creativity, not an automaton."[86] The Federal Circuit provides that the POSITA "is also presumed to be one who thinks along the line of conventional wisdom in the art and is not one who undertakes to innovate."[87] Under these two opinions, it seems a creative AI system cannot be the POSITA. Further, the programmer may know the AI program, but the programmer may have

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[82] 35 U.S.C. 103 (2019).
[83] Joseph P. Meara, *Just Who Is the P Just Who Is the Person Having Ordinary Skill in the Art? Patent Law's Mysterious Personage*, 77 WASH. L.R. 267 (2002).
[84] Standard Oil Co. v. American Cyanamid Co., 774 F.2d 448, 454 (Fed. Cir. 1985) (citing the statement of the district court that "a hypothetical inventor is envisioned as working in his shop with all the prior art references — which he is presumed to know — hanging on the walls around him").
[85] Tull & Miller, *supra* note 76, at page 319.
[86] KSR v. Teleflex, 550 U.S. 398, 421 (2007).
[87] Standard Oil Co., 774 F.2d at 454.

very limited knowledge in the specific field to which an AI system is applied (e.g., medical and business) and cannot be presumed to know "all the pertinent prior art" as required by the Federal Circuit. [88] Some argue that if the use of AI is common practice in the field at issue, a POSITA could be a person equipped with an AI system.[89] We call this a heightened POSITA standard—when an AI system is at the hands of a POSITA to access obviousness, the bar to gauge creativity may be raised due to the expanded capacity of the AI tool. Then is it fair to use the heightened standard to evaluate an invention made by AI while using the old POSITA standard to view an invention made by humans? If we still place the human-made inventions and the AI-made inventions under the same examination system, it seems biased to have two POSITA standards just because of who or what is the inventor. We therefore propose to establish an AI patent track model to separate the examination AI inventions from that of human-made inventions. The distinctive systems would allow the change of POSITA standards without introducing much prejudice

Second, applying the motivation test to examine whether an AI patent is obvious seems counterproductive if the POSITA is just a person without using AI systems. Under the motivation test developed by the Federal Circuit, we ask whether the prior art contains a motivation to modify the prior art in order to produce the claimed new invention.[90] AI tools are extensively used to address complicated puzzles and the complexity may deter a person from building over the prior art to achieve the AI generated solution. As a result, the motivation test may be satisfied due to the intricacy of the problem rather than the degree of innovativeness.

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[88] *Id.*

[89] Center for the Fourth Industrial Revolution, *Artificial Intelligence Collides with Patent Law*, WORLD ECONOMIC Forum 12 (April 2018), http://www3.weforum.org/docs/WEF_48540_WP_End_of_Innovation_Protecting_Patent_Law.pdf.

[90] In re Kahn, 441 F.3d. 977 (Fed. Cir. 2006). In *KSR*, however, the Supreme Court found the TSM test is not wrong but too rigid and narrow.

This appears to lower the motivation bar for AI inventions that are targeted for complex problems. We warn that a motivation bar that is too low would result in a flood of junk patents which may hamper the true innovation.[91]

Third, the "obvious-to-try" test in the eyes of a POSITA, based on predictability and reasonable expectation of success is also not applicable. In *KSR*, the Supreme Court proposed an obvious-to-try criterion in which "a finite number of identified, predictable solutions" with "anticipated success" would render a combination of prior art obvious.[92] AI has an unpredictable feature based on its algorithm of random mutations.[93] Such nature might present AI generated results to someone as unexpected and not obvious to try, inducing mediocre patents that are not so inventive patentable and consequently blocking innovation and congesting the patent office and courts.

When facing a completely new problem, like the newly discovered COVID-19, the skilled person's perspective would be limited, and the prior art would be sparse. It takes some time for a skillful artisan to be familiarized with the nuances of the newly emerged crisis and to decipher the implications from the prior art. When the ordinary person's view may lag behind the emergency, the traditional POSITA standard is not suitable to evaluate the rapidly created solutions to a novel issue One may argue that a POSITA can quickly pick up the information regarding the new emergency and the relevancy of prior art because a POSITA is a *hypothetically* capable person "who is presumed to be aware of all the pertinent prior art" as pointed by the Federal Circuit.[94] However, the POSITA standard is in fact implemented by

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[91] Center for the Fourth Industrial Revolution, *supra* note 89, at 12.

[92] KSR v. Teleflex, 550 U.S. 398, 422 (2007) (stating the invention is obvious when "there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions.")

[93] Yanisky-Ravid & Liu, *supra* note 22, at 2224 (summarizing that one of the features of AI is unpredictability).

[94] Standard Oil Co. v. American Cyanamid Co., 774 F.2d 448, 454 (Fed. Cir. 1985).

human patent examiners during patent examination. The standard is more or less arbitrary and gives little guidance to real people who are examining inventions of unique capabilities pertaining to novel concerns like the coronavirus. Hence, the delay in understanding a newly emerging exigency like COVID-19 would still interfere with the obviousness evaluation for patentability.

The confusion of the POSITA standard calls for a change of such standard. Under the new AI patent track model to be further discussed later, we propose a revision of POSITA to "a skilled person using an ordinary AI tool in the art". Just like an *ordinary* person skilled in the art referring to an artisan who cannot take significant creative leaps, we define the *ordinary* AI tool as an AI system that is routine, not able to create or generate new inventions by itself, and has already been disclosed by prior art. This standard would envision a person equipped with an AI system to assess pending AI patent applications fairly, quickly, and efficiently. Even when faced against a novel concern like the coronavirus, a skilled person with an ordinary AI system can quickly grasp the recent information collected from the circumstances and become well equipped to assess the obviousness standard.

In addition, we reason that the timing of patent examination subjects AI inventions to *post hoc* bias. The average wait time for the USPTO to provide the result of first substantive examination of a patent application is about 21 months.[95] An invention that was nonobvious at the time of conception might nonetheless appear obvious when it is evaluated by the patent office or courts some years later.[96] On the other hand, AI is today's hot commodity and the

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[95] *How long does it take to get a patent?*, ERICKSON LAW GROUP, http://www.ericksonlawgroup.com/law/patents/patentfaq/how-long-does-it-take-to-get-a-patent/(last visited Nov. 17, 2019).

[96] Rebecca S. Eisenberg, *Obvious to Whom? Evaluating Inventions from the Perspective of PHOSITA*, 19 BERKELEY TECH. L.J. 885, 887 (arguing that the USPTO lacks any procedures for consulting the judgement of current technological practitioners when applying the POSITA standard and proposing for the review of the POSITA standard by the outside technological practitioners).

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number of AI startups has grown exponentially in recent years.[97] The long wait period for patent examination is in sharp contrast with the astonishing growth speed of the AI industry. The rapid evolvement of AI technology is likely to render hindsight rejections at the lengthy examination process. To solve this problem, we call on accelerated patent examination and a corresponding shorter lifetime for AI inventions also in consideration of the quick elimination rate of the technology. These considerations for the new patent track model will be detailed later. Next, the issues of written description and enablement are discussed.

C. Written Description and Enablement

35 USC 112(a) requires a written description of the process of making and using the invention "in such full, clear, concise and exact terms as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and use" the invention.[98] We argue that Section 112(a), which encompasses both a clarity requirement and an enablement requirement on the specification of the patent, present challenges for AI inventions.

First, the clarity requirement poses an obstacle to patent AI inventions because the advanced AI systems are perhaps unexplainable with the "blackbox" conundrum.[99] As an example, the AI platform Deep Patient predicts diseases by learning the vast database of patient records.[100] Without expert instruction, Deep Patient discovered patterns hidden in the medial data and successfully anticipated some diseases, including one that is notoriously difficult for physicians to predict. The team lead of the Mount Sinai group who developed Deep Patient admits that the system offers no clue as to how it works and says "we can build these models, but

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[97] *Id.*

[98] 35 U.S.C. 112(a) (2019).

[99] David, Leslie, *Understanding Artificial Intelligence Ethics and Safety*, ALAN TURING INSTITUTE 4 (2019), https://www.turing.ac.uk/sites/default/files/2019-06/understanding_artificial_intelligence_ethics_and_safety.pdf.

[100] Will Knight, The Dark Secret at the Heart of AI, MIT TECH. R. (Apr. 11, 2017), https://www.technologyreview.com/s/604087/the-dark-secret-at-the-heart-of-ai/ ("No one really knows how the most advanced algorithms do what they do. That could be a problem.").

we don't know how they work".[101] The reason of Deep Patient's explanation problem is due to the system's basis on deep neural networks, an AI class of machine learning, which have notoriously been blamed for lack of transparency for long; despite of its powerful capability, the deep neutral networks rarely provide insight as to what is actually going on during the innovation process.[102]

Second, the "blackbox" conundrum challenges the enablement requirement, which requires the written description of a patent application to be sufficient enough to *enable* a skillful artisan to "make and use" the invention.[103] The unexplainable features of AI even puzzle its developers, as seen in the case with Deep Patient, thus an ordinary person who is not involved in the development of AI system will have a much harder time being *enabled* by the written description. No matter how detailed a description of an AI system is, it may be deemed unclear or *not* enabling considering the complex nature and unexplainable nuances of the technology.

When the world is presented with an exigency such as the fight against COVID-19, we turn to advanced technologies to find a solution. If there is an AI tool that can be used to combat the virus accurately and efficiently, it is of minimal importance to focus on why or how the AI system works. If a complex AI system can solve such a pressing issue, the urgency does not allow time to reconstruct the AI system to enhance the explainability. To address the lack of transparency within an AI system, we suggest the use of a depository rule for AI working models

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[101] *Id.*

[102] Devinder Kumar et al., *Explaining the Unexplained: A Class-Enhanced Attentive Response (CLEAR) Approach to Understanding Deep Neural Networks*, IEEE CONFERENCE ON COMPUTER VISION AND PATTERN RECOGNITION WORKSHOPS (CVPRW) (July 2017), http://openaccess.thecvf.com/content_cvpr_2017_workshops/w26/papers/Kumar_Explaining_the_Unexplained_CVPR_2017_paper.pdf ("This lack of transparency and interpretability of DNNs [Deep Neural Networks] during the decision-making process is largely due to the complex nature of DNNs, where individual neural responses, unlike other interpretable decision-making processes such as decision trees, provide very little insight as to what is actually going on.").

[103] 35 U.S.C. 102(a).

to sufficiently describe the inventions. With the deposited AI models, even if the patent specification may not explain the AI inventions clearly, the "as is" models demonstrate whether the claimed AI inventions could work and how the AI inventions actually work. The depository rule can also address the issues arising from the utility requirement below.

D. Utility

The utility requirement necessitates the specification to disclose a use that corresponds in scope to the subject matter sought to be patented.[104] The basic test of utility is that an invention must be "operable", i.e., "capable of being used to effect the object proposed."[105] The unexplainable features of AI may bring doubts about how the AI system generates the resulting solution. If a skillful person is unable to decipher the mechanics of the AI system, the person may not be able to effectuate the proposed object of the invention. According, the "blackbox" conundrum calls the utility requirement into question too. In the COVID-19 climate, a person's understanding of the novel virus is very limited and the AI mechanisms may be inexplicable, thus he or she may be uncertain about how to operate the new AI tools to achieve the claimed result of the patent application. The person's confusion in regard to the claimed outcome of the patent application would lead to a doubt whether the application fulfills the utility requirement. We will later discuss the depository requirement of AI working models, which can address the uncertainty of utility and enhance the transparency as to the function of the inventions.

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[104] *In re* Langer, 12503 F.2d 1380, 1391(CCPA, 1974) ("a specification which contains a disclosure of utility which corresponds in scope to the subject matter sought to be patented must be taken as sufficient to satisfy the utility requirement of § 101 for the entire claimed subject matter unless there is a reason for one skilled in the art to question the objective truth of the statement of utility or its scope").
[105] Mitchell v. Tilghman, 86 U.S. 287 (1873).

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E. Novelty

The novelty requirement under 35 USC 102 is based on the doctrine of anticipation, which requires the subject matter in the patent application to be unknown or otherwise not part of any prior art.[106] The USPTO notes that "[a] claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference."[107] With respect to an AI invention, does the anticipation of each and every element necessitate a clarity of each and every element of an AI invention? If the unexplainable feature of an AI system makes it impossible to clearly delineate the inventions, can we still apply the doctrine of anticipation fairly? Issues with the novelty requirement seem to mimic the previous concerns of clarity and transparency with AI tools, to which we advise can be addressed by the AI depository rule as well.

F. Inventorship

Before the introduction of the America Invents Act (AIA), the pre-AIA section 35 USC 102(f) required the named inventor to have made the discovery himself or herself.[108] Although there is no equivalent provision in the AIA enacted in 2013, a patent that names inventors who did not *actually* create the invention can still be invalidated under 35 USC 100(f) (providing the definition of "inventor" to mean "who invented or discovered the subject matter of the invention") or stricken down for inequitable conduct based on a deception as to inventorship.[109]

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[106] Jeffrey M Kaden, *Patent Protection And The Novelty Requirement*, GOTTLIEB RACHMAN & REISMAN, P.C., https://grr.com/publications/patent-protection-novelty-requirement/ (last visited Apr. 22, 2020).

[107] § 2131 Anticipation—Application of 35 U.S.C. 102, Manual of Patent Examining Procedure (MPEP), USPTO, https://www.uspto.gov/web/offices/pac/mpep/s2131.html (citing Verdegaal Bros. v. Union Oil Co. of California, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987) (last visited Apr. 22, 2020)).

[108] The pre-AIA patent law has a clause under 35 USC 102(f) to bar a patent in which the named inventor "did not invent the subject matter sought to be patented".

[109] Alex Wolcott, *Failure to Name Joint Inventors May Bar Patentability*, GLOBAL IP & TECH. BLOG (May 20, 2018), https://www.iptechblog.com/2018/05/failure-to-name-joint-inventors-may-bar-patentability/ (outlining a case in which the failure to name the proper inventors who actually conceive the invention resulted in invalidation of a patent).

This presents challenges for naming inventors for an AI system that independently creates an invention. If a patent application of an AI creativity system lists its human AI developers who admit have not invented the subject matter, the patents may be at risk for invalidation under inventorship misrepresentation.

The humans behind an AI system may arguably not conduct any creative acts by merely writing codes to construct the AI system, providing data, and training, or pushing the operational buttons. In the objective sense, humans behind the AI systems should not be the claimed inventors if they have not done anything indisputably creative. Nevertheless, the Constitution[110], 35 USC 100[111], and 35 USC 101[112] all require the creators of inventions to be human. The law clearly favors humans rather than machines in the inventorship issue. In Ryan Abbott's article published on the WIPO Magazine, he contends that "allowing people to take credit for work they have not done would devalue human inventorship. It would put the work of someone who merely asks an AI to solve a problem on an equal footing with someone who is legitimately inventing something new."[113]

We hereby assert a dilemma for AI inventive systems: if the humans behind them claim to be the inventors, but they have not made a creative contribution, they are not legitimate inventors; if the AI systems that create the inventions are listed on patent applications as inventors, the AI systems are not legitimate inventors under the patent law. The dilemma of designating inventorship to neither an AI system nor an AI engineer would confuse the AI professionals, frustrate the research endeavor, and hinder the scientific progress. We therefore

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[110] U.S. CONST. art. I, Article I, § 8, cl. 8 (providing the grant of patents to "inventors").
[111] 35 U.S.C. § 100 defines an inventor as, "the *individual* or, if a joint invention, the *individuals* collectively who invented or discovered the subject matter of the invention".
[112] 35 U.S.C. § 101 provides for the grant of a patent to "whoever invents" a patentable invention.
[113] Ryan Abbott, *The Artificial Inventor Project,* WIPO Magazine (June 2019), https://www.wipo.int/wipo_magazine/en/2019/06/article_0002.html.

advise the patent office to clarify the inventorship question especially when the creative act is performed by the AI system rather than a human being.

The concept of inventorship for AI-made inventions must be distinguished from the concept of ownership. Inventorship deals with who actually created or invented the subject matter of the invention, while ownership refers to those who own patents and thus have the legal rights and duties. It is the patent owners, *not* inventors that have the right to enforce their patents against infringers and meanwhile have the obligation to respect others' patent rights by not intruding upon. AI systems may not take on such rights and responsibilities of patent owners because it cannot practically benefit from compensatory damages or be accountable for any wrongdoings.

As discussed above, the current patent law regime has posed substantial hurdles and uncertainties for patenting AI inventions in regard to the issues of subject matter eligibility, utility, novelty, non-obviousness, written description, enablement, and inventorship. In view of the most, if not all, aspects of the current law that are not suitable for AI inventions, changing one aspect of patent law may not be a solution. Therefore, we advocate to establish a completely new patent track for AI inventions as an alternative model to solve the problem.

IV.   AN ALTERNATIVE MODEL—AI SPECIFIC PATENT TRACK MODEL

COVID-19 has severely altered our day to day lives and it has also presented new challenges for patent law in regard to AI technology. Patenting AI inventions intended to combat COVID-19 may encounter problems in almost all patent requirements in terms of patent-eligible subject matter, obviousness, written description, enablement, utility, novelty and inventorship. When we urgently need anti-virus cure in response to a rapidly evolving health crisis, these

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patentability issues may discourage the researchers' effort to develop new diagnostics and treatments.

Unlike those who propose marginal changes to the existing patent law framework[114], and against those who argue for the entire inapplicability of patent law,[115] we propose a new patent track model which adopts a separate system of standards and grants different rights specifically for AI inventions. We recommend that the new AI patent track model features the following characteristics:

A. Protection of Creative AI Systems and AI-Made Inventions

As discussed above in the section of patent-eligible subject matter, creative AI systems and AI-made inventions may encounter patenting obstacles by allegedly reciting mental steps, mathematical operation, generic computer implementation, or laws of nature in the field of medical diagnostics. We argue that such inventions should be patentable to incentivize innovation and to reward the labor. Specifically, we present the theoretical justification for creative AI systems (including both algorithms and trained models) and AI-made inventions under the law-and-economics theorem and the labor theory.

According to the law-and-economics approach, the public and the inventors agree on a contract in which the inventors have exclusive rights for a limited period of time over their inventions to incentivize innovation, while the public is entitled to access to the inventions after the period expires.[116] An AI creative system that can generate innovations by itself comprises at least two components: one is the underlying AI algorithms and the other the trained model resulting from the learning and training outcomes of the AI system. We recommend the AI

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[114] Ramahlho, *supra* note 32; Kohlhepp, *supra* note 33.
[115] Yanisky-Ravid & Liu, *supra* note 22, at 2216-2017.
[116] RICHARD A. POSNER, ECONOMIC ANALYSIS OF LAW 40(6th ed. 2003).

patent track model recognizes both components of AI creative systems as patentable subject matters in view of the law-and-economics justification.

First, we contend that allowing patenting of AI algorithms, a part of AI creative systems, would incentivize the research on fundamental AI building blocks. Not only does it boost the advancement of AI technology itself, more importantly, it encourages the technological development in various fields, such as medical, engineering, and science. As we exemplify above, the AI platform that combines facial recognition with fever reporting to flag potential coronavirus patients[117] and the AI system that forecasts the virus outbreak before it happens[118] are both the kind of AI algorithms that need to be facilitated by patent protection in the public health exigencies. In an April hearing regarding oversight of the USPTO hosted by the Senate Committee on the Judiciary, the USPTO director Andrei Iancu indicates "human-made algorithms that are cooked up, invented as a result of human ingenuity are different from discoveries and mathematical representations of those discoveries."[119] The statement gave some hope on patenting AI algorithm as it presented the agency's opinion that creative algorithms are distinguishable from the otherwise unprotectable mathematical representations. We look forward to seeing future legislative initiatives aimed at fixing the challenges of the patent system in the AI context.

Second, we maintain that allowing the patenting of AI trained models, another part of creative AI system, would incentivize trainers and data scientists to generate new resourceful AI models in an attempt to solve practical problems. AI trained models are extremely sophisticated

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[117] Feng, *supra* note 62.
[118] Niler, *supra* note 8.
[119] Steve Brachmann, USPTO Director Andrei Iancu Discusses Patentability of Algorithms, PTAB Proceedings at Senate Judiciary Committee (Apr. 19, 2018), https://www.ipwatchdog.com/2018/04/19/uspto-director-andrei-iancu-patentability-algorithms-ptab-senate-judiciary/id=96059/.

at finding answers by learning from the training data and target attributes.[120] DeepMind, for example, is a trained model that learns how to solve problems and advances discovery in various fields such as science, medicine, and energy.[121] A medical AI model developed by the Center for Clinical Artificial Intelligence in Cleveland can predict the patient's risk of death within 48 to 72 hours of hospital admission which enables clinicians to create prioritized plans for the most critical conditions.[122] In the pandemic, AI trained models flourish extensively in the form of diagnostic tools. The Israel company that used the AI systems to analyze the vocal features of coronavirus patients has an AI trained model to recognize new patients based their voices.[123] The Canadian group trying to diagnosis COVID-19 by CT chest images has an AI trained model that learn from numerous CT lung images of coronavirus patients. Allowing patenting of the AI trained models would remedy the difficulty in patenting medical diagnostic tools which may be alleged to recite a law of nature. The patent protection of AI trained models would incentivize more investment in the researching and teaching of AI systems to make them better serve our needs of humanity.

Third, we reason that patent protection of AI-made inventions would boost efficiency in research and development, leading to more innovation in useful products and processes. The investors are encouraged by economic returns via licensing and sales from the exclusive patent rights in AI-made inventions. "[The] wealth-generating characteristics of innovation

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[120] *Training ML Models*, AMAZON MACHINE LEARNING, https://docs.aws.amazon.com/machine-learning/latest/dg/training-ml-models.html (last visited Nov. 21, 2019) ("The process of training an ML model involves providing an ML algorithm (that is, the learning algorithm) with training data to learn from. The term ML model refers to the model artifact that is created by the training process. The training data must contain the correct answer, which is known as a target or target attribute.").

[121] *Scientific Advances, Real World Benefits*, DEEPMIND, https://deepmind.com/impact (last visited Nov. 21, 2019).

[122] Aziz Nazha, Does AI Have a Place in Medicine?, SCIENTIFIC AMERICAN (Nov. 11, 2019), https://blogs.scientificamerican.com/observations/does-ai-have-a-place-in-medicine/ ("we have been able to identify (at high rates of accuracy) patients at high risk of death within 48 to 72 hours of hospital admission, which enables clinicians to take proactive steps to treat them in ways that mitigate further risk.").

[123] *Supra* note 79.

fundamentally justify a broad interpretation of patentable subject matter."[124] In the pharmaceutical industry, the best-selling drug *Humira* for treating arthritis made almost 2 billion for its patent owner in 2018.[125] Every time a news outlet reported that a drug may treat COVID-19, the holder of the drug patent would have an astonishing jump in its asset valuation.[126] The pharmaceutical companies desire the financial yield from patent rights to compensate for the expensive and long drug development process—the process usually cost billions and require 10-12 years before the drug is even placed on the market.[127] The highly lucrative market and the efficiency boost by the AI technology would encourage the industry to engage in more AI strategies to make new inventions.

On the other hand, the labor theory provides that an inventor has an inherent right to the fruits of his labor and the patent right is awarded for the hard work that the inventor contributes to his creation.[128] To develop an AI system, the substantial amount of work by AI professionals (including programmers, data suppliers, trainers, data scientists, etc.) deserves patent rights. The AI programmer drafts algorithms as the AI building block. The data supplier provides the AI system with data to learn from. The trainer teaches and corrects the AI system in the learning

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[124] Erik S. Maurer, *An Economic Justification for a Broad Interpretation of Patentable Subject Matter*, 95 Nw. U. L. Rev. 1057, 1058 (2001) (arguing that "all patents, regardless of their subject matter, possess inherently wealth-generating potential" and "free markets will determine what subject matters should be patented". The article also argues that "artificial and subjective limits on patentable subject matter would weaken the efficient, market-driven system contemplated by our existing patent laws").

[125] Bob Herman, *Humira Sales Approach $20 Bilion*, AXIOS (Jan. 25, 2019), https://www.axios.com/abbvie-humira-2018-sales-20-billion-e4039176-baeb-44ff-b4fe-1b63005283b9.html ("[g]lobal sales of Humira, the blockbuster drug that treats autoimmune diseases like arthritis and psoriasis, hit $19.9 billion in 2018, an 8.2% increase from 2017.").

[126] *See* Sergei Klebnikov, *Gilead Stock Jumps 8% After Coronavirus Drug Remdesivir Shows 'Rapid Recoveries' In Clinical Trials*, FORBES (Apr. 17, 2020), https://www.forbes.com/sites/sergeiklebnikov/2020/04/17/gilead-stock-jumps-8-after-coronavirus-drug-remdesivir-shows-rapid-recoveries-in-clinical-trials/#7c8cdcb61c9a.

[127] *Product development lifecycle: New drug development*, MARS STARTUP TOOLKIT, https://learn.marsdd.com/article/product-development-lifecycle-new-drug-development/ (last visited Apr. 19, 2020).

[128] JOHN LOCKE, THE SECOND TREATISE ON CIVIL GOVERNMENT 20 (Prometheus Books 1986) (1690).

process.[129] The data scientist assists data supplier and trainer to sort out data suitable for the AI function.[130] A successful AI system may require labor from a large group of collaborative professionals and their consistent work through the lifetime of the system. We note the difference between rewarding patent rights and the designation of inventorship or ownership. Even with a grant of patent rights to the invention, the inventorship may not necessarily flow to the AI professionals if their contribution is not creative.

The patent protection of creative AI systems (including AI algorithms and AI trained models) and AI-made inventions would incentivize innovation and reward labor. Not only do we propose the new patent track model to incorporate wider scope of patent protection for AI inventions, we also recommend the following rules for the new track model.

B. Change of the POSITA Standard

The POSITA standard may not be applicable in the obviousness assessment for AI inventions under both the motivation test and the "obvious to try" analysis. The Federal Circuit has many factors[131] to evaluate the skill level possessed by a POSITA; however, as Ryan Abbott alleges, the court may have ignored an important factor—technologies used by active workers which is highly relevant to the active workers' skills.[132] If the use of AI is a standard skill in the AI industry, the POSITA who is "presumed to be aware of all the pertinent prior art"[133]

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[129] Yaniv Taigman et al., *DeepFace: Closing the Gap to Human- Level Performance in Face Verification* 1–8 (June 24, 2014), https://research.fb.com/wp-content/uploads/2016/11/deepface-closing-the-gap-to-human-level-performance-in-face-verification.pdf?.

[130] Cassie Kozyrkov, Top 10 Roles in AI and Data Science, KDNUGGETS (Aug. 2018), https://www.kdnuggets.com/2018/08/top-10-roles-ai-data-science.html ("[A] data scientist is someone who is a full expert in all of the three preceding roles" including the role of expert analyst, statistician, and applied machine learning engineer.).

[131] *In re* GPAC Inc., 57 F.3d 1573, 1579 (Fed. Cir. 1995) (including the factors of 1) educational level of the inventor; 2) types of problems encountered in the art; 3) prior art solutions to those problems; 4) rapidity with which inventions are made; 5) sophistication of the technology).

[132] Ryan Abbott, *Everything Is Obvious*, 66 UCLA L. Rev. 2, 38-39 (arguing that "[i]nventive machines are increasingly being used in research, and once the use of such machines becomes standard, the person skilled in the art should be a person using an inventive machine, or just an inventive machine").

[133] Standard Oil Co. v. American Cyanamid Co.*,* 774 F.2d 448, 454 (Fed. Cir. 1985).

according to the Federal Circuit standard should also know how to use an *ordinary* AI tool that is routine and by itself not creative. We propose that the POSITA standard under the AI patent track model characterize "a skilled person using an *ordinary* AI tool in the art". We identify the *ordinary* AI tool as an AI system that has already been disclosed in the prior art and by no means cover the AI creativity machine that can invent by itself.

The previous concerns under the obviousness requirement are based on the motivation test and the "obvious-to-try" analysis in which a person skilled in the art may lack motivation to address complex problems that AI tools are good at or the person might not certainly try a seemingly unanticipated AI solution generated. The current POSITA standard might render an AI invention satisfying the nonobviousness requirement too easily just because the invention is intended to address the intricate problems in a seemingly unforeseen way. To resolve the implication of the obviousness requirement in respect to AI inventions, our proposed the POSITA standard of "a skilled person using an ordinary AI tool in the art" would help a professional understand the complexity of the AI algorithm, the versatility of the AI system, and the complication of the problem in the pending patent application. With the proper understanding of the AI invention, a skilled person could have an equitable perspective in assessing the obviousness criterion.

It is particularly appealing to enabling a POSITA to use an ordinary AI tool in evaluating AI inventions in the age of a pandemic. As an ordinary person may need time to understand the sudden predicament, an ordinary AI tool empowers a skilled artisan to extrapolate the new field quickly and efficiently. The patent examination demands such adaption to better effectuate the finding of fresh solutions during the coronavirus crisis and for future unpredictable situations.

C. Expedited Patent Examination

The time it takes to acquire a patent is crucial in the COVID-19 urgency. In light of the temporal constraints of the patent system, the long wait period for patent examination may discourage organizations from investing in researching a cure for the virus. By the time a COVID-19 drug patent is granted, a pharmaceutical company may have already missed the peak in demand for the drug and therefore may not be able to reap the highest rewards. On May 8, 2020, the USPTO announced a COVID-19 Prioritized Examination Pilot Program that endeavors to speed up the deposition of COVID-19 patent application.[134] However, the effect of the pilot program can only be limited, since merely a small portion of patent applicants—small or micro entity status filing for product or process claims subject to FDA approval— can participate in the pilot program. Neither does it solve the delay problem of patenting posed to large entities such as the "Big Pharma" companies that have the most resources to develop the COVID-19 cures, nor would it promote many patent matters that do not require FDA approval such as disease forecasting or tracking.

Above we discussed the *post hoc* bias arising from the lengthy review time for patent applications and that is why we argue for an expedited patent examination for AI inventions. Not only does the expedition address the hindsight problem, but it also aims to avoid administrative backlogs that the patent office may encounter. "The AI boom is happening all over the world

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[134] *USPTO Announces COVID-19 Prioritized Examination Pilot Program for Small and Micro Entities*, USPTO (May 8, 2020), https://www.uspto.gov/about-us/news-updates/uspto-announces-covid-19-prioritized-examination-pilot-program-small-and. Independent from the USPTO's effort to expedite the patenting process of COVID-19 related patent applications, the FDA created a special program, Coronavirus Treatment Acceleration Program (CTAP), to speed the FDA review process for coronavirus therapies so that the drugs are placed into clinical trials or the market faster. *See Coronavirus Treatment Acceleration Program (CTAP)*, U.S. FOOD & DRUG ADMINISTRATION, https://www.fda.gov/drugs/coronavirus-covid-19-drugs/coronavirus-treatment-acceleration-program-ctap (last visited June 3, 2020); *Coronavirus (COVID-19) Update: FDA Issues Emergency Use Authorization for Potential COVID-19 Treatment*, U.S. FOOD & DRUG ADMINISTRATION, https://www.fda.gov/news-events/press-announcements/coronavirus-covid-19-update-fda-issues-emergency-use-authorization-potential-covid-19-treatment (last visited June 3, 2020).

and it's accelerating quickly."[135] In 2017, there were over 10,000 AI related publications and over 130,000 AI patent families in U.S.[136] If not examined in a fast fashion, the AI patent applications may pile up quickly. The lapse of time during examination may also allow competitors to grow, and by the time of patent's grant, the technology may not be so advanced or useful as it was previously.

Even though the USPTO has a prioritized patent examination program (Track One), the program charges a high fee and is not specific to any type of technology.[137] In contrast, Singapore recently launched the Accelerated Initiative for Artificial Intelligence (AI^2), a fast track specific for AI related patent applications that are firstly filed in Singapore.[138] AI^2 is expected to grant an AI patent in a fast as 6 months.[139] We urge the USPTO to set up a new patent track model specific for AI inventions. If such an expedited track model is not adopted, the U.S. risks the outward flow of investment and innovation to other countries, where the patent systems that are more favorable to AI patents.

D. Use of AI for Patent Examination

We advise the use of AI tools for patent examination to review the difficult algorithms and vast amounts of data which may be overwhelming for humans to handle, as the AI tools would boost efficiency and accelerate the patent examination process. The USPTO has already

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[135] Nick Statt, *The AI Boom Is Happening All Over The World, And It's Accelerating Quickly* (Dec. 12, 2018), https://www.theverge.com/2018/12/12/18136929/artificial-intelligence-ai-index-report-2018-machine-learning-global-progress-research.

[136] Yoav Shoham et al., *The AI Index 2018 Annual Report*, STANFORD U. HAI (Dec. 2018), http://cdn.aiindex.org/2018/AI%20Index%202018%20Annual%20Report.pdf.

[137] *USPTO's Prioritized Patent Examination Program*, USPTO, https://www.uspto.gov/patent/initiatives/usptos-prioritized-patent-examination-program (last visited Nov. 21, 2019) ("The USPTO offers Track One for prioritized examination of your utility and plant patent applications. Track One gives your application special status with fewer requirements than the current accelerated examination program and without having to perform a pre-examination search. Prioritized examination is available for a fee at the time of filing an original utility or plant application.").

[138] Chong Koh Ping, *Singapore to fast-track AI patent applications* (Apr. 27, 2019), https://www.straitstimes.com/tech/singapore-to-fast-track-ai-patent-applications ("Intellectual Property Office to cut processing time from 2 to 4 years to as little as 6 months.").

[139] *Id.*

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been using the AI system Unity to increase the efficiency of patent examination.[140] The application of Unity seems limited to searching patents, publications, and images, rather than examining patents.[141] In a crisis like the coronavirus pandemic, AI systems could curate the prior art fast and efficiently and they could also analyze the creativity of the patent application from continuously updated databases and circumstantial information. Similar to the way AI systems help the pharmaceutical industry screen drug candidates, AI systems would likewise assist the patent examiners filter away unpatentable applications so as to lighten the workload for human examination.

A legal idealist would desire the perspective of the patent examiner identical to that of a POSITA given that a POSITA's viewpoint is the golden standard in evaluating whether a pending patent application is patentable. In a realistic way, the human examiners' opinions can only be, at the best, as close as possible to the POSITA standard. In line with our proposed POSITA standard of "a skilled person using an ordinary AI tool in the art", patent examiners' use of AI tools for examination helps maintain their perspective in consistency with the standpoint of a POSITA. The AI tools for patent examination would help evaluate the patentability of AI inventions based on an enhanced understanding of the relevant field and the pending AI patent application.

E. Shortened Patent Lifetime

"In the AI industry, the invention process as well as product life cycles can sometimes be extremely short."[142] AI patents may not need 20 years lifetime like utility patents. We plead to

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[140] *Remarks by Director Iancu at the Artificial Intelligence: Intellectual Property Considerations Event* (Jan 31, 2019), https://www.uspto.gov/about-us/news-updates/remarks-director-iancu-artificial-intelligence-intellectual-property.

[141] *Id.*

[142] Yanisky-Ravid & Liu, *supra* note 22, at 2254.

shorten the patent lifetime for AI patents which would allow the technology to come to the

public domain faster for the benefit of knowledge dissemination. We do not agree with a

complete suspension of patent rights because it would "throw a wet blanket" over the passion to

develop new AI solutions. One may argue that to shorten patent lifetime would deter the effort of

AI research and development. We contend that shorten the patent lifetime should still cover the

most favorable time to exclusively make, sell, use, and import the invention. Though

pharmaceutical companies hope to have their drugs under patent protection for as long as

possible, a coronavirus drug, for example, may not need a full span of 20 years for exclusive

patent rights on the grounds that the virus may evolve, the drug formula may be upgraded, and

other drugs from competitors may be introduced to the market. The privilege of the

pharmaceutical industry needs to be balanced with the interests of low-income patients who

benefit from cheaper generic drugs that can only be introduced into the market after the

expiration of patents allowing.

F. Depository Requirement for the AI Working Models

To solve the "blackbox" conundrum of AI technology which implicates issues with the

written description, enablement, novelty, and utility requirements, we propose a depository rule

for the AI working models. The deposition requirement has been around for a long time

specifically for the patent application involving microorganisms. When an invention involves a

microorganism, it is usually impossible to clearly and sufficiently desalinate the structure or

component of the matters such as bacteria, yeast, fungi, or viruses.[143] In response to the difficulty

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[143] *Id.* ("[I]nventions involving the use of new microorganisms (i.e., those not available to the public) present problems of disclosure in that repeatability often cannot be ensured by means of a written description alone…This line of reasoning led to the industrial property offices in an increasing number of countries either requiring or recommending that the written disclosure of an invention involving the use of a new microorganism be supplemented by the deposit of the microorganism in a recognized culture collection.").

in describing living organism, in 1977 World Intellectual Property Organization (WIPO) enacted the Budapest Treaty to codify the depository principle for microorganisms.[144] Each of the state parties agreeing to the Budapest Treaty, including the U.S., is obliged to adopt the deposition rule for microorganisms as part of the patent procedure of that country or region. During patent application, the applicants are expected to mail a sample of microorganisms to the patent office as a record in the office's sample library.

In analogy to microorganisms, we urge a depository rule for AI systems, which encounter the same difficulty of being inexplicable. The depository AI model may include key components of the AI systems such as codes, data, and output results via a digital submission to the patent office. The deposited AI models could be used as a showcase to illustrate the AI subject matters, and to answer how does the AI system work, how to make and use the AI tools as claimed in the patent application, or what does the components of the AI tools stand for. The demonstration of AI models would address the problem of insufficient description that implicates many patentability criteria including written description, enablement, novelty, and utility requirements; the deposition may also serve as potential evidence in the later infringement case.

V.   POTENTIAL CHALLENGES OF THE AI SPECIFIC PATENT TRACK MODEL AND REBUTTALS

Below some potential challenges of the new AI patent track model are laid out and rebutted. First, some may assert that AI patents may prevent the later comers to use the patented technology. For example, since the AI algorithm is fundamental to AI systems, an AI algorithm patent would preempt subsequent applications arising from that algorithm.[145] We reason that the

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[144] *Introduction to the Budapest Treaty*, WIPO, https://www.wipo.int/export/sites/www/treaties/en/registration/budapest/guide/pdf/introduction.pdf (last visited Nov. 22, 2019) (""Budapest Treaty on the International Recognition of the Deposit of Microorganisms for the Purposes of Patent Procedure").

[145] Allen Newell, *Response: The Models Are Broken, the Models Are Broken*, 47 U. PITT. L. REV. 1023, 1034 (1986); Pamela Samuelson, *Benson Revisited: The Case Against Patent Protection for Algorithms and Other*

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patent right is not equal to the monopoly in the antitrust sense.[146] Indeed, the patent reflects a balance between the need to encourage innovation and the avoidance of monopolies.[147] The demand of incentives to promote new technology may be prioritized in some circumstances, like during the current health crisis when people are dying every day because no approved efficient drugs or vaccine are available.

Patenting AI inventions does not prevent the patent owners from licensing out their advanced technology.[148] The licensees could enjoy the granted privilege to create a subsequent work, e.g., application of the AI creativity system to generate a resulting new invention.[149] The license could be accommodated to the public interests depending on how urgent and essential is the purported use. Recently, some politicians from around the world call for the compulsory patent licensing relating to coronavirus vaccines and treatments in consideration of patent rights that might prevent affordable access to potential cures.[150] Most European countries, India, and Canada have already evoked compulsory licensing under which the governments may authorize themselves or third parties to use a patent without the permission of the patent owner.[151] However, in U.S. there is no general right to force compulsory licensing. The "march-in rights" under the Bayh-Dole Act of 1980 may at most compel licensing of a federally-funded patent

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Computer Program-Related Inventions, 39 EMORY L.J. 1025, 1137 (1990) ("Because of the stronger monopoly right that they convey, patents do seem likely to increase barriers to entry significantly in the software market.").

[146] American Hoist & Derrick Co. v. Sowa & Sons, Inc., 725 F.2d 1350, 1367 (Fed. Cir. 1984) cert. denied, 469 U.S. 821 (1984) ("The patent system, which antedated the Sherman Act by a century, is not an 'exception' to the antitrust laws, and patent rights are not legal monopolies in the antitrust sense of that word.").

[147] Bonito Boats, Inc. v. Thunder Craft Boats, Inc. 489 U.S. 141, 146 ("The Patent Clause itself reflects a balance between the need to encourage innovation and the avoidance of monopolies which stifle competition without any concomitant advance.").

[148] Chisum, *supra* note 29, at 1018 ("[L]icensing of the patent rather than exclusive control will normally be the most feasible strategy for optimizing revenue.").

[149] *Id*.

[150] Adam Houldsworth, *Global Calls for Compulsory COVID-19 Patent Licensing Build*, IAM (May 21, 2020), https://www.iam-media.com/coronavirus/global-calls-compulsory-covid-19-patent-licensing-build.

[151] Nafsika Karavida et al., *Patent Rights and Wrongs in the COVID-19 Pandemic: EU and U.S. Approaches to Compulsory Licensing*, IP Watchdog (May 19, 2020), https://www.ipwatchdog.com/2020/05/19/patent-rights-wrongs-covid-19-pandemic-eu-u-s-approaches-compulsory-licensing/id=121709/.

rather than a drug or vaccine patent developed by a "Big Pharma".[152] The best bet in U.S. to use

a pharmaceutical company's patent is still through the consent of the patent owner. In view of

the priority of ensuring access to life-saving medicines during pandemic, pharmaceutical

companies may be willing to compromise their patent rights temporarily. For example, Gilead

owns the patent of the potential coronavirus drug remdesivir and its CEO announced that at the

time of crisis "the patent is not at the forefront of our mind" and "[w]e will not get into a patent

dispute" even considering that China's Wuhan Institute of Virology filed a new patent

application to use Gilead's potential coronavirus cure.[153] Gilead emphasized that "it is too early

to discuss any compulsory or other types of licensing at this stage" and its priority now is to

examine the drug efficacy in clinical trials and to later ramp up the product after confirmed

clinical results.[154]

The open source advocate who support the complete elimination of patent rights may

allege that patent protection of proprietary information limits the accessibility of knowledge.

Despite the current call for harmonized research effort from governments, academic institutions,

and industry to develop COVID-19 vaccine, the unwillingness to share patentable information

may prevent the collaboration.[155] We argue that patent owners regularly work together under the

confidentiality agreement and the open source model provides no incentive for the profit-driven

patent owners, e.g. pharmaceutical companies, to develop cures.

Some may question whether patent rights do induce the inventive effort since scientists

may work for sense of achievement or personal glory not necessarily in pursuit of economic

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[152] *Id.*

[153] Jacob Schindler, *Gilead downplays Chinese lab's coronavirus patent*, IAM (Feb. 10, 2020), https://www.iam-media.com/coronavirus/gilead-downplays-chinese-labs-coronavirus-patent.

[154] *Id.*

[155] Lawrence Corey et al., *A Strategic Approach to COVID-19 Vaccine R&D*, SCIENCE (May 29, 2020), https://science.sciencemag.org/content/368/6494/948.

returns. The degree of the inducement for invention by patent rights varies by fields. An empirical study shows that the manufacturing industry would still have chosen to develop most of their products even if the companies had known the products are not patentable.[156] However, executives in the pharmaceutical industry reported without patent protection 60% of the new pharmaceuticals would not have been developed. The pharmaceutical companies may indeed require the patent incentives to induce the research and development activities.

Other kinds of IP rights, such as copyright or trade secrets, may be raised as alternative to patent in the AI context.[157] We contend that the patent right provides much more incentive to innovate for the AI professionals and investors than the alternatives. While the copyright prevents the competitors from copying the codes, the patent right grants a right to bar competitors entirely from the market.[158] Trade secrets, on the other hand, do not provide incentive to innovate, nor do they encourage the dissemination of knowledge as the patent disclosure offers upon the expiration of rights. As the patent right is more exclusive, encompassing, and transparent, it is thus more incentivizing to innovation.

The employment worry may emerge that the incentive offered to the AI industry in the form of patent rights would threaten the human workforce.[159] A study published by McKinsey Global Institute suggests that up to 800 million jobs around the world could be under threat from automation in the next 12 years.[160] We note that the automation, necessitated by the industrial

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[156] Richard D. Nelson & Roberto Mazzoleni, *Economic Theories About the Cost and Benefits of Patents*, *in* INTELLECTUAL PROPERTY RIGHTS AND THE DISSEMINATION OF RESEARCH TOOLS IN MOLECULAR BIOLOGY 17, 20 (1996), https://www.ncbi.nlm.nih.gov/books/NBK233535/.

[157] Samuelson, *supra* note 145, at 1135 ("[B]ecause both copyright and trade secret protection seemed to be available to protect programs, it appeared that patent protection was not needed.").

[158] *Id*, at 1136.

[159] James Vincent *Automation Threatens 800 Million Jobs, But Technology Could Still Save Us, Says Report,* VERGE (Nov. 30, 2017), https://www.theverge.com/2017/11/30/16719092/automation-robots-jobs-global-800-million-forecast.

[160] James Manyika et al., *Jobs Lost, Jobs Gained: What the Future of Work Will Mean For Jobs, Skills, and Wages*, McKinsey (Nov. 2017), https://www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-

development, is inevitable even without AI. The exponential growth rate of computer performance indicated by Moore's law has been continuously accelerating the industrialization speed even before the birth of AI and such trend would keep eliminating human workers who are conducting only routine repetitive work. Indeed, the job market created by AI cannot be ignored. The work force may adapt to the expanding AI industry as the McKinsey study indicates "when some tasks are automated, employment in those occupations may not decline but rather workers may perform new tasks" by switching occupations or upgrading skills to accommodate the job market.[161] The employer demand for AI-related role has more than doubled from 2015-2018.[162] It is expected that from 2018 to 2022, AI would create 58 million new jobs around the world.[163]

In the coronavirus pandemic, there is concern that granting a 20-year patent monopoly to a coronavirus drug would boost price gouging and hinder the iterative innovation by a second comer who later develops a similar drug. We contend that stripping patent rights from a pharmaceutical company would deprive the incentives and make it almost impossible to recoup the decade-long cost in drug research and development. Further, without patent benefits, the scientists and researchers may feel insufficiently rewarded for their fruits of productive labor. We notice a patent maximalist' view in support of an extension of patent term for coronavirus cures beyond the current norm of 20 years,[164] yet we do not agree with the elongated patent term—under our proposed AI-specific patent track model, we summon a shorted patent lifetime

the-future-of-work-will-mean-for-jobs-skills-and-wages ("We estimate that between 400 million and 800 million individuals could be displaced by automation and need to find new jobs by 2030 around the world.").

[161] *Id.*

[162] Alison DeNisco Rayome, *Demand for AI Talent Exploding: Here Are the 10 Most In-Demand Jobs*, TECHREPUBLIC (Mar. 1, 2018), https://www.techrepublic.com/article/demand-for-ai-talent-exploding-here-are-the-10-most-in-demand-jobs/.

[163] Amit Chowdhry, *Artificial Intelligence To Create 58 Million New Jobs By 2022, Says Report*, FORBES (Sept. 18, 2018), https://www.forbes.com/sites/amitchowdhry/2018/09/18/artificial-intelligence-to-create-58-million-new-jobs-by-2022-says-report/#6f56c98e4d4b.

[164] Mossoff, *supra* note 16.

to balance the incentive with the concern of exclusive rights. In the coronavirus climate, Senator Ben Sasse' takes a compromised position to support patent incentives. In his recent bill Facilitating Innovation to Fight Coronavirus Act, the Senator suggests a delay of patent rights during the pandemic and offered, as compensation for the delay, an extension of a patent term by 10 years.[165] This legislation may address the current urgency to provide a cure and meanwhile offers a longer time of patent protection to incentivize future to lever for innovations.

VI. CONCLUSION

COVID-19 is affecting all facets of life and every walk of life. The patent right is not free from the coronavirus influence. The pandemic provides us with an opportunity to rethink the current patent system, especially in regard to the utilization of AI tools to fight the virus. Many patent law implications arise from AI innovations, suggesting the inapplicability of the current patent law to AI-made inventions and creative AI systems. We therefore urge an innovative model to solve the problem by establishing a completely new patent track model specific for the application and examination of AI inventions.

It is critical to establish a new AI patent track on the grounds that the current patent law regime has posed substantial hurdles and uncertainties for patenting AI inventions with regard to almost all patentability requirements. We analyzed each of the issues in the article—including subject matter, eligibility, utility, novelty, non-obviousness, written description, enablement, and inventorship–to demonstrate that most, if not all, aspects of patent law are not suitable in the AI era; only a revolutionary new patent track specific for AI inventions could solve all the concerns while maintaining the patent incentive for innovations.

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[165] Facilitating Innovation to Fight Coronavirus Act, S. [number not yet available], H.R. 116th Cong. § 2 (2020).

In our proposal, the new AI patent track provides a distinctive scope of protection for creative AI systems (including innovative AI Algorithm and AI trained models) and AI-made inventions—all of which might potentially not be patentable under the current patent regime. To clarify the specifications of AI inventions that may be inherently inexplicable, the track innovatively requests the deposition of AI working models with the patent office. The new track also revolutionizes many ambiguous or inapplicable elements of the patent law to be more congruent with the 3A era digital tools in the aspects of the "person skilled in the art" standard, the examination timing and method, and the patent lifetime.

The article seeks to address many patent issues in the age of the pandemic. However, many questions remain unanswered: Who should own the patent resulting from AI inventions? Who should hold liability at patent enforcement? Does the infringement action call for a change of the doctrine of equivalent in the AI context? One thing is for sure—we want to harness the capabilities of AI to enhance humanity. When we are challenged at difficult times like now in the COVID-19 era, the humanity enhancement can be achieved through the application of the presented new patent track model. In the words of Virginia Rometty, current IBM chair, president and CEO, "[s]ome people call this artificial intelligence, but the reality is this technology will enhance us. So instead of artificial intelligence, we think we'll augment our intelligence."[166]

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[166] John Carpenter, *IBM's Virginia Rometty Tells NU Grads: 'Technology Will Enhance Us'*, CHICAGO TRIBUNE (June 19, 2015), https://www.chicagotribune.com/business/blue-sky/ct-northwestern-virginia-rometty-ibm-bsi-20150619-story.html.